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Properties of AlN single crystals doped with Beryllium via high temperature diffusion

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Abstract

© 2018 Author(s). We report on co-doping of high-quality AlN single crystals by group II Beryllium acceptors by means of diffusion from the vapour phase at a temperature of 1850 °C. We discovered that Be is characterized by the high diffusion length, allowing one to produce Be co-doping of sub-mm-thick AlN wafers. We show that Be diffusion led to the quenching of the visible (VIS) 450 nm (2.75 eV) and deep ultraviolet (UV) 265 nm (4.7 eV) optical absorption bands with simultaneous induction of the absorption band peaked at 248 nm (5 eV). By means of electron paramagnetic resonance (EPR), we also found that the presence of Be impurities compensated the donor type paramagnetic centers. Correlation of the EPR data with the optical absorption allowed us to conclude that Be produced in the AlN via diffusion acted predominantly as an acceptor, inducing the shift of the Fermi level to the lower part of the AlN bandgap. This shift of the Fermi level results in recharging of the deep level defects in the AlN bandgap, which explains the observed quenching of the VIS and UV absorption bands.

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